

## **AMENDMENTS TO THE SPECIFICATION**

Please replace the paragraph beginning on page 3, line 15 with the following amended paragraph:

“In addition, as for the SMF whose effective cross-sectional area  $A_{\text{eff}}$  is increased, the theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode has a tendency to shift to a longer wavelength region. This presents a problem in that the effective operating wavelength region is limited to a longer wavelength region of 1400 nm or more, for example (refer to Japanese Patent Application Laid-open No. 2001-147338 (Claim 13 and paragraph [0022], for example).”

Please replace the paragraph beginning on page 6, line 16 with the following amended paragraph:

“According to the present invention, it becomes possible to satisfy all the characteristics of the bending loss equal to or less than 1 dB/m at the bending radius 10 mm, and the effective cross-sectional area  $A_{\text{eff}}$  equal to or greater than  $150 \mu\text{m}^2$  in a region in which the theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode is equal to or less than 1500 nm and the operating wavelength is from 1260 nm to 1625 nm, for example, by providing, in addition to the core region and first cladding region having the same refractive index gradient as that of a conventional single mode fiber, the second cladding region having at least four air hole regions within the first cladding region, and by optimizing the core radius  $r_1$ , the relative index difference  $\Delta$  of the core region, the air hole radius  $r_2$ , and the distance  $d$  of the air hole regions, thereby offering a marked advantage of being able to implement the reduction in the optical nonlinearity in a wide single mode operation region.”

Please replace the paragraph beginning on page 7, line 6 with the following amended paragraph:

“In addition, according to the present invention, it also becomes possible for the single mode fiber with the same structure as described above to satisfy the theoretical cutoff wavelength in the higher-order LP<sub>11</sub> mode equal to or less than 1500 nm and the bending loss equal to or less than 1 dB/m at the bending radius 10 mm in the operating wavelength region from 1260 nm to 1625 nm, and to implement high bending loss resistance, to keep the MFD characteristics equivalent to that of the conventional SMF at the wavelength 1310 nm, and to make the variations in the MFD with reference to the conventional SMF equal to or less than  $\pm 10\%$  even at the wavelength 1625 nm, thereby offering an advantage of being able to achieve good connection characteristics with the conventional SMF.”

Please replace the paragraph beginning on page 8, line 22 with the following amended paragraph:

“Fig. 4 is a characteristic diagram illustrating relationships between the normalized air hole distance  $d/r_1$  and the theoretical cutoff wavelength in the higher-order LP<sub>11</sub> mode of a hole-assisted single mode optical fiber of a first embodiment in accordance with the present invention;”

Please replace the paragraph beginning on page 9, line 27 with the following amended paragraph:

“Fig. 10 is a characteristic diagram illustrating relationships between the relative index difference  $\Delta$  in the core region and the theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode of the hole-assisted single mode optical fiber in the second embodiment in accordance with the present invention.”

Please replace the paragraph beginning on page 13, line 27 with the following amended paragraph:

“Fig. 4 is a diagram illustrating relationships between the normalized air hole distance  $d/r_1$  and the theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode of a hole-assisted single mode optical fiber in which the number of air holes is eight, and the air hole radius  $r_2$  is 0.4 times the core radius  $r_1$ . The theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode of the foregoing conventional SMF whose relative index difference  $\Delta$  is 0.32% and the core radius  $r_1$  is 4.5  $\mu\text{m}$  is about 1450 nm. The hole-assisted single mode optical fiber in accordance with the present invention can also achieve the cutoff wavelength characteristic equivalent to that of the conventional SMF or less as illustrated in Fig. 4.”

Please replace the paragraph beginning on page 15, line 12 with the following amended paragraph:

“Therefore, it is possible to achieve the characteristics that enable the relative variations in the present MFD with reference to the MFD of the conventional SMF to be curbed equal to or less than  $\pm 10\%$  even at the upper limit 1625 nm of the operating wavelength by making the theoretical cutoff

wavelength in the higher-order  $LP_{11}$  mode equal to or less than 1500 nm, by making the bending loss characteristic at the bending radius 10 mm equal to or less than 1 dB/m in the operating wavelength region from 1260 nm to 1625 nm, and by making the MFD at the wavelength 1310 nm from about 7.9  $\mu\text{m}$  to 10.2  $\mu\text{m}$  which is equivalent to that of the conventional SMF by making the design of the hole-assisted single mode optical fiber in accordance with the present invention, which has at least four air hole regions 12 as shown in Figs. 2, 3A-3C, 4, 5 and 6, in the range in which the distance  $d$  of the air hole regions 12 is 2.0 – 4.5 times the core radius  $r_1$ , the radius  $r_2$  of the air hole regions 12 is 0.2 times the core radius  $r_1$  or more, the relative index difference  $\Delta$  of the core region 10 is about 0.3% to 0.55%, and the core radius  $r_1$  is about 3.7  $\mu\text{m}$  to 4.8  $\mu\text{m}$ .”

Please replace the paragraph beginning on page 17, line 27 with the following amended paragraph:

“In addition, Fig. 10 is a diagram illustrating relationships between the relative index difference  $\Delta$  of the core region 10 and the theoretical cutoff wavelength in the higher-order  $LP_{11}$  mode when using the relationships between the relative index difference  $\Delta$  and the effective core radius  $A$  at the wavelength 1260 nm of Fig. 8.

Please replace the paragraph beginning on page 18, line 6 with the following amended paragraph:

“Therefore, as shown in Figs. 8, 9 and 10, it is possible for the second embodiment in accordance with the present invention, in the single mode fiber with six air hole regions 12 which are placed at the distance  $d = 3 \times r_1$  from the center of the core region 10 and have the radius  $r_2 = 0.3 \times r_1$ , to achieve the characteristics that enable the effective cross-sectional area  $A_{\text{eff}}$  in the wavelength

range from 1260 nm to 1625 nm to be equal to or greater than  $150\ \mu\text{m}^2$ , and the bending loss at the bending radius 10 mm to be equal to or less than 1 dB/m by making the theoretical cutoff wavelength in the higher-order  $\text{LP}_{11}$  mode equal to or less than 1100 nm by making the design in the range in which the relative index difference  $\Delta$  of the core region 10 is equal to or less than about 0.12%, and the effective core radius  $A$  is about from  $23\ \mu\text{m}$  to  $28\ \mu\text{m}$ .